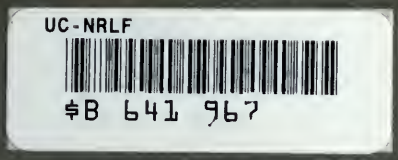

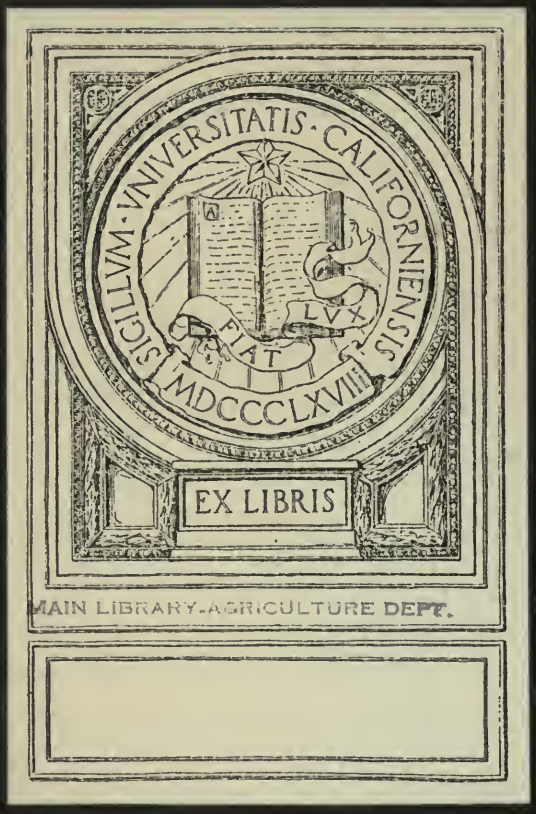

On the Influence of Solubility on Availability.

BY

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Various former experiments carried out in Komaba and Nishigahara have shown that for several Gramineae the best ratio of lime to magnesia lies between 1/1 and 2/1. With oats the yield was nearly equal in both cases while with upland rice the ratio 1/1 was more favorable than 2/1 and for barley before its flowering period 2/1 was more favorable. With the development of seed, however, relatively more magnesia is required and also in the case of barley the final ratio will be nearer to 1/1 than 2/1. These ratios, however, correspond to equal availability of lime and magnesia, both having been applied as natural carbonates or as nitrates. The ratio of lime to magnesia entering the plant changes, however, very considerably when one of the compounds is insoluble in water while the other is soluble. The latter will then much more readily enter into the plant body than the former.

My former experiment[1] with rice showed that with artificial carbonate of lime and with magnesia as cryst. sulphate, the best ratio in sand culture was $\frac{\text{CaO as carbonate}}{\text{MgO as sulphate}} = \frac{30}{1}$.

I have carried out a similar experiment with barley in sand culture, applying the lime in the form very finely powdered lime stone. Each pot contained 4.5 Kg of dry sand and received the following general manure applied in five fractions :

$NaNO_3$	10 Gr.
K_2SO_4	10 Gr.
KH_2PO_4	1.5 Gr.

While the amount of lime was constant that of magnesia was varied as follows :

1). This Bulletin Vol. I, No. 1, p. 23–29.

No. of pots.	CaO : MgO	Powdered lime stone.	$MgSO_4+7H_2O$.
I.	5 : 1	80.4 g	54.96 g
II.	10 : 1	„ „	27.48 „
III.	20 : 1	„ „	13.74 „
IV.	30 : 1	„ „	9.16 „
V.	40 : 1	„ „	6.87 „
VI	50 : 1	„ „	5.50 „
VII.	60 : 1	„ „	4.58 „
VIII.	70 : 1	„ „	3.44 „

The seeds of barley (*var. Goldenmelon*) were sown Nov. 10, 1904 and after germination the young plants were reduced to 6 of equal size. The growth in all the pots started equally well but gradually differences appeared, plants in No. I and II were far inferior in growth while the plants in No. VII and VIII were of the most luxurient development as shown by the following measurements made on Jan. 9, 1905. In the beginning of February the plants in pots No. 1 died off.

Table I.

No. of Pots.	CaO : MgO.	Average length of the longest leaves.	Average number of stalks p. pot.
I. pot 1	5 : 1	9.5 cm.	1
I. pot 2		9.0 „	1
II. pot 1	10 : 1	10.5 „	1.8
II. pot 2		10.5 „	2.2
III. pot 1	20 : 1	18.1 „	3.8
III. pot 2		18.8 „	3.8
IV. pot 1	30 : 1	20.1 „	4.2
IV. pot 2		20.1 „	4.5
V. pot 1	40 : 1	20.6 „	5.0
V. pot 2		21.7 „	5.3

No. of Pots.	CaO : MgO.	Average length of the longest leaves.	Ayerage number of stalks p. pot.
VI. pot 1	50 : 1	23.2 cm.	5.9
VI. pot 2		23.3 „	5.8
VII. pot 1	60 : 1	23.2 „	6.8
VII. pot 2		26.0 „	6.8
VIII. pot 1	80 : 1	24.9 „	6.9
VIII. pot 2		24.3 „	6.9

The plants were cut on June 10, dried and weighed with the following result, to which are added the observation on the plants in pot No. I; these died in February.

Table II.

No. of pots.	CaO : MgO	Number of stalks.		Number of ears.		Aver. length of stalks	
		p. pot.	Average.	p. pot.	Average.	of each pot	Average.
I. pot 1	5 : 1	10	9	...	...	9.0	8.5
I. pot 2		8		...		7.5	
II. pot 1	10 : 1	19	22	...	5	45.0	45.9
II. pot 2		25		5		46.8	
III. pot 1	20 : 1	43	42.5	43	41	96.0	96.0
III. pot 2		42		39		96.0	
IV. pot 1	30 : 1	41	41.0	40	41	96.0	99.5
IV. pot 2		41		41		102.9	
V. pot 1	40 : 1	36	45.0	35	44	102.0	99.3
V. pot 2		54		52		96.6	
VI. pot 1	50 : 1	48	48.0	48	46	97.5	94.8
VI. pot 2		48		43		92.1	

No. of pots.		CaO : MgO	Number of stalks.		Number of ears.		Aver. length of stalks.	
			p. pot.	Average.	p. pot.	Average.	of each pot	Average.
VII.	pot 1	60 : 1	...[1]	50 0	...	47	...	97·5
	pot 2		50		47		97·5	
VIII.	pot 1	80 : 1	51	49·5	51	49	93.0	95 9
	pot 2		48		47		98.7	

Table III.

No. of pots.		CaO : MgO	Seeds g	Stalks g	Chaff g	Root g	Total g	Average p. pot g	
								Seeds	Total
I.	pot 1	5 : 1[2]	.....	... ..	.....	.....	.....	.....	.....
	pot 2		.....	.....	.....	.....	.....		
II.	pot 1	10 : 1[2]	.... .	13.50	.....	1.88	15.38	0.38	26.26
	pot 2		0.38	28.88	0.38	7·50	37.14		
III.	pot 1	20 : 1	18 38	79.50	4·50	15.75	118.13	25.69	128.26
	pot 2		33.00	82.88	3.75	18.75	138.38		
IV.	pot 1	30 : 1	29.63	82.50	6.00	18.13	136.26	31.51	135.45
	pot 2		33 38	81.00	4.13	16.13	134.64		
V.	pot 1	40 : 1	25.13	72.38	3.75	16.50	117.76	20.26	144.39
	pot 2		15.38	121.50	4.88	29.25	171.01		
VI.	pot 1	50 : 1	24.75	104 63	6.00	15.00	150.38	26.82	144·58
	pot 2		28.88	92.63	4.13	13.13	138.77		

1). Some plants in this pot were attacked by fungus and cut off before ripening.

2). In these two cases it is very probable that not only a certain excess of available magnesia, but also the salt concentration itself, caused the depression of the yield. All soluble salts, though not directly injurious to the plant, would perhaps cause the depression when applied in such concentration.

No. of pots.	CaO : MgO	Seeds g	Stalks g	Chaff g	Root g	Total g	Average p. pot g Seeds.	Total.
VII. pot 1	60 : 1	.....	.....	.....	.....	.....	52.13	159.01
VII. pot 2		52.13	88.88	6.00	12.00	159.01		
VIII. pot 1	80 : 1	40.50	98.25	6.38	18.00	163.13	41.63	157.70
VIII. pot 2		42.75	91.50	4.88	13.13	152.26		

The above result shows clearly that in the presence of lime as carbonate, the necessary amount of magnesia applied in the form of crystallized sulphate for barley in sand culture is so small that the best ratio of lime to magnesia becomes 60 : 1, while in the form of nitrates of calcium and magnesium in water culture the best ratio for Gramineae between 1/1 and 2/1. This conclusion will hold good also for various sandy soils, while for clayey soils the best ratio is $\frac{\text{CaO as carbonate}}{\text{MgO as sulphate}}$ will differ, as T. NAKAMURA[1] ascertained. The calculation from the above results shows that with barley 4.9 parts $MgSO_4.7H_2O$ are agronomically equivalent to 100 parts magnesite, while with rice this equivalent is still higher viz. 9.8.

1). This Bulletin Vol. I, No. 1, P. 30–34.